Chapter -2
ENGINEERING SURVEYS AND INVESTIGATIONS

2.1 General

Various surveys and investigations that are the essential inputs for detailed engineering design are detailed in this chapter. All the relevant maps / data / details available with the concerned departments have been collected, compiled and reviewed. Particular attention has been given to past / historical data / reports. A review of the past data available in the various studies has been listed out and such available data has been made use of, after updating / augmenting the data wherever necessary. The data as collected has been made use of in analysis, design, formulation of improvement proposals and costing. The activities have been performed on several fronts fully complying with the requirements. The activities that are carried out are brought out hereunder.

The various engineering surveys / investigations of the road sections include:

- Reconnaissance Survey.
- Visual Topographical Survey.
- Road Inventory Survey.
- Pavement Condition Survey.
- Visual Condition Survey.
- Structure Condition Survey
- Soil, geo-technical, material, hydrology and drainage surveys

2.2 Reconnaissance Survey

Reconnaissance Survey of the road, considered for improvements, has been carried out to identify the general condition of roads, drains, culverts and bridges for further surveys / investigations, to understand kind of establishments along the stretches of roads and to work out land acquisition scheme. Making use of the observations / data collected during reconnaissance survey, detailed schedule for surveys / investigations required for the project has been finalized.

2.3 Visual Topographical Survey

Topographic Survey has been conducted all along the corridor by physically measuring the Road Width, Footpath Width, Drain Width, Alignment of Road and with the aid of Google Maps.

2.4 Road Inventory Survey

A detailed inventory and condition survey of road sections has been carried out by making use of well structured inventory data format. It was compiled in tabular form, developed using Excel computer software. Various data collected during the road inventory broadly include.

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- Type of terrain.
- Land use.
- Carriageway width.
- Type of surfacing.
- Shoulder, Median, Drain (tertiary / shoulder), Footpath - type and width.
- Road Geometry.
- Road Furniture.
- Salient Buildings & Structures.
- Road Intersection(s) and their details.
- Land width (RoW).
- Culverts, bridges and other structures (type, size, span arrangement and location).
- General drainage conditions.

2.5 Pavement Condition Survey

The Pavement Condition Survey has been carried out in accordance with IRC Guidelines. All surveys and investigations have been carried out with the following objectives:

- To have an up to date record of road assets.
- To have a clear understanding of road side features including land use, drainage characteristics, etc. and
- To assess the condition and strength data for developing improvement proposals and related designs.

2.5.1 Visual Condition Survey

Visual Condition Survey of the road sections has been carried out by travelling along the patching, rutting, pot holes, edge breaking, etc. by visual observations in a well structured data format. The data so collected has been compiled and presented (kilometer wise) in the form of tables for easy understanding. This data has been used to assess the pavement condition.

2.5.2 Soil, geotechnical, material, hydrology and drainage surveys

(i) The activities and Deliverables forming part of the soil, geotechnical, material, hydrology and drainage surveys are described below:

(a) The characteristics of the existing soil of the Project road.

(b) The determination of sub grade CBR (soaked) Project road.

(c) Benkelman Beam Deflection measurements on the Project road for overlay stretches.

(d) Preliminary hydraulic data for bridges, design discharge, HFL, LWL, etc. with a view to checking adequacy of existing waterway.

(e) A broad assessment of the drainage condition and requirement of the Project Highway.

(ii) Road signs, safety devices

(a) The provision of Road Signs, Pavement Markings, Safety Barriers, Railings,

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Delineators, Chevron Markings, Traffic Attenuators. It shall also include Crash Barriers for existing bridges.

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Chapter -3

DESIGN STANDARD & SPECIFICATION

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Chapter -3
DESIGN STANDARD & SPECIFICATION

3.1 General

Planning and design of roads & CD structures, pedestrian facilities and street furniture are essentially based on the IRC standards and MoRT&H specifications. Whenever, the codes / standards are silent on some of the aspects, the same has been planned / designed based on sound engineering practices. Design standards relevant to the project road along with the broad list of design parameters and the relevant IRC codes / specifications have been detailed in **Table 3.1.**

Table 3.1: Design Standards

SL No.	Design Parameters	Reference Code
1.	Geometric Design Standards • Carriageway width • Shoulder • Footpath • Median • Camber • Super Elevation • Horizontal Alignment • Vertical Alignment	As per IRC: 38 - 1988, IRC: 86 - 1983 & IRC: SP : 23 – 1993
2.	Road Furniture • Road Delineators • Road Markings • Road Signs	As per IRC: 79 – 1981 As per IRC: 35 – 1997 As per IRC: 67 – 2001
3.	Road Capacity	As per IRC: 106 – 1990
4.	Pavement Design	As per IRC: 37 – 2012 & IRC: 58 – 2011
5.	Overlay Design	As per IRC: 81 – 1997
6.	Road Drainage	As per IRC: SP: 42 - 1994 & IRC: SP: 50 - 1999
7.	Culverts	As per relevant IRC codes and MoRT&H

The project road section passes through plain terrain. Design standards (as appropriate) have been further elaborated under the following heads:

- ❖ Geometric Design
- ❖ Pavement Design
- ❖ Overlay Design
- ❖ Drainage
- ❖ Road Furniture and Appurtenances
- ❖ Bridges and CD Structures

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3.2 Design Standards Related to Geometric Design

Design standards related to road geometric along with the suggested design values / standards and recommended values based on site conditions and data analysis are detailed in Table 3.2.

Table 3.2: Geometric Design Standards

SL No.	Design Parameters	Design Values
1.	Design Speed	Design speed Considered is 40 kmph.
2.	Geometric Design Standards	
	• Carriageway Width	Two lane/ Four lane carriageway
	• Camber (Bi-directional)	2.5% for paved carriageway.
	• Super Elevation	Limited to 4%.
	• Footpath	Minimum width - 1.5m
	• Kerb	Barrier / Semi — barrier / Mountable (Barrier type recommended)
	• Extra Widening at Curves	Nil for Radius above 300 m
	• Gradient	Maximum Gradient - 4.0 % (1 in 25) Minimum Gradient for Drainage - 0.5 % (desirable minimum) & 0.3 % (absolute minimum).

3.3 Design Standards Related to Pavement Design

Design standards related to Pavement design are essentially based on the guidelines given in IRC: 37 - 2012 "Tentative Guidelines for the Design of Flexible Pavements ". The suggested design values / standards and recommended values based on site conditions and data analysis are detailed in Table 3.3 and are adapted in the design.

Table 3.3: Overlay Design Standards

SL No.	Design Parameters	Reference Code / Design Values
1.	Pavement design	IRC: 37 - 2012 " Tentative Guidelines for the Design of Flexible Pavements "
	Initial Traffic	In terms of CVPD, vehicles weighing more than 3 ton
	Traffic growth rate	5%
	Design Life	10 to 15 years
	Vehicle damage factor	1.5 to 4.5
2.	Soil Characteristics	CBR Value

3.4 Design Standards Related to Overlay Design

Design standards related to Overlay design are essentially based on the guidelines given in IRC: 81 - 1997 "Guidelines for Strengthening of Flexible Road Pavements Using

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Benkelman Beam Deflection Technique". The suggested design values / standards and recommended values based on site conditions and data analysis are detailed in Table 3.4 and are adapted in the design.

Table 3.4: Overlay Design Standards

SL No.	Design Parameters	Reference Code / Design Values
1.	Overlay Design	IRC: 81 - 1997 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique"
	• Design Life	10 years
	• Correction Factors	Temperature Correction Factor. Correction for Seasonal Variation (inclusive of correction for moisture content, soil type and rainfall)
	• Minimum Thickness	From structural considerations recommended minimum bituminous overlay thickness is 40 mm AC (minimum) or 50mm BM (as required) + 40mm BC
2.	Wearing Course Material (Options)	Bituminous Concrete with Crumb Rubber Modified Bitumen / Plastic Waste.

3.5 Design Standards Related to Road Drainage

Drainage of water from pavement surface is of paramount importance as far as preserving the road assets created by investing huge funds in addition to maintaining the structural soundness and functional efficiency of the road. Design standards related to road drainage are essentially based on the guidelines given in IRC: SP: 42 — 1994 "Guidelines on Road Drainage" and in IRC: SP: 50 - 1999 "Guidelines on Urban Drainage". The suggested design values / standards are detailed in **Table 3.5.**

Table 3.5: Design Standards Related to RoadDrainage

SI No.	Design Parameters	Design Values
1.	• Camber	1.7 - 2.5 % (bi - directional) for carriageway (camber of 3% is adopted).
	• Longitudinal Gradient	Minimum 0.3 - 0.5% for satisfactory drainage
	• Drain Type	Cast in situ RCC box drain with Precast RCC cover slab. RCC box culverts across cross roads.
	• For Existing Drains	Desilting and Rectification of Damaged Portion

3.6 Design Standards Related to Road Furniture and Appurtenances

Utility and importance of the road are greatly enhanced by installing road furniture and appurtenances at appropriate locations along the project road, which ensures improved road safety. Planning and design of road furniture and appurtenances are as per the guidelines

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stipulated in IRC. Detailing of each of these components has been done so as to integrate the same with the road improvement scheme. The suggested design values / standards are detailed in **Table 3.6.**

Table 3.6; Design Standards Related to Road Furniture and Appurtenances

SL No.	Design Parameters	Reference Code / Design Values
1.	Road Markings	IRC: 35 - 1997 "Code of Practice for Road Markings".
2.	Road Signs	IRC: 67 - 2001 "Code of Practice for Road Signs".
3.	Road Delineators	IRC: 79 - 1981 "Recommended Practice for Road Delineators".
4.	Pedestrian Facilities	IRC: 103 - 1988 "Guidelines for Pedestrian Facilities".

In addition to the above measures various other integral road components have been planned so as to achieve the maximum and optimal use of the carriageway with no / least interference to traffic flow at the same time ensuring adequate facilities to other road users especially pedestrians. All the encroachments, if any shall be cleared within the RoW.

3.7 Design Standards Related to Bridges and CD Structures

The design standards and loading considered for culverts and bridges are as stipulated in latest IRC codes / Special publications supplemented by appropriate MOST circulars and/or IS codes. The unsafe and/or deficient bridge and culvert structures (existing) will be rehabilitated or replaced by sound structures.

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Chapter -4
DESIGN & PROPOSALS

4.1 General

Improvement proposals for an existing road section essentially consist of two components, geometric and structural improvements. Geometric improvement deals with visible dimensions of roadway, probable road widening and is dictated by the traffic and economic considerations. Due to the inherent restrictions like limitation in land acquisition, limited right of way and existing utilities / services, etc. the horizontal and vertical alignments in general follow the existing geometry except in situations where improvements are possible. The geometric improvements mainly involve improvements to cross sectional elements such as carriageway, shoulders, etc. The structural component deals with the pavement and embankment design aspects, i.e., the ability of the roads to adequately carry and support the Vehicle / wheel loads over the design period. Safety, speed, efficiency, economy and comfort in traffic movement to a large extent are governed by adequacy of design standards used for a specific road facility.

The improvement proposals need to consider the method of widening like concentric or eccentric to the existing road which is dictated by site situations like available land for acquisition, curvature, existing utilities, terrain, places of worship, monuments, grave yards, places of importance etc.

This chapter deals with the analysis of data collected during various engineering surveys/investigations and the formulation of improvement proposals including planning and design.

4.2 Road Inventory and Physical Characteristics of Road Section

Investigations / studies have been carried out along the Project Stretch. Physical characteristics of these road and road Junctions are as follows. The Project area is located thickly populated Residential cum Commercial area. The Project Stretch includes connecting roads and cross roads. For the habitation resided in this area it was very difficult to commute on this stretch in the Rainy season due to non proper flow of water on the Roads and lack of proper drainage facility. By considering these reasons the roads are taken up for Development with Asphalting or White topping depending upon the site scenario.

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Terrain along this section is generally plain. Width of Carriageway (Undivided Carriage Way and Divided Carriage Way) along the Road varies. The Road carries considerable vehicular traffic throughout the day especially during peak hours. Considerable pedestrian traffic is also present along the corridor.

4.3 Pavement Design

Pavement design forms an integral part of detailed engineering study. Performance of pavement is critical as the economical returns are directly dependent on its performance. This chapter deals with the design methodology adopted for the construction, strengthening and rehabilitation of the existing carriageway and the also suggests the design approach for both flexible and rigid pavement for the new carriageway. This chapter also brings out the present condition of the project corridor, the pavement option study and suggests the best alternate design.

This Section describes the studies and investigation carried out on Traffic, existing pavement conditions, existing soil sub grade condition and existing embankment / Soil at OGL condition. New pavements are generally flexible, consisting of Granular Sub-base, Water Mix Macadam, Bituminous macadam and wearing course in Bituminous Concrete.

4.4 Pavement Design Methodology

Pavement design methodology includes two basic functions namely; design of strengthening and Widening for existing pavement and design of new crust for new Pavement to be adopted shall be decided based on life cycle cost analysis as a part of pavement design methodology. Accordingly, the following Methodology has been adopted in Pavement design.

Step 1: Various Pavement investigations have been carried out on the project corridor to assess the adequacy of the existing pavement crust. These investigations include:

- Visual Pavement Condition
- Visual shoulder condition
- BBD measurements
- Sub grade investigations
- Investigations on existing soil / granular layers

Step 2: Detailed material investigations have been conducted in the projected influence area and strength characteristics and availability of construction material has been determined.

Step 3: Design thickness of overlay has been estimated from IRC-81-1997 using estimated traffic level and characteristic deflection of particular homogeneous section. Estimated BM thickness is then adjusted to equivalent thickness of BC & DBM using conversion factors given in IRC 81-1997.

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Step 4: Homogeneous sections for pavement design have been established and design traffic Loadings for each of them identified. Design of flexible pavement for new road has been carried out in accordance with guidelines of IRC-37-2012.

4.5 Flexible Pavement Design

4.5.1 Design CBR

Existing soil sub grade samples were collected through Trial Pit excavations at Road and shoulder interface. The existing soil sub grade were tested as per IS 2720.

The equivalent CBR is obtained as per IRC 37-2012 Chart for 905 dependability is 10%. Hence the flexible pavement design has been carried out using the IRC code (IRC-37-2012). In this code, pavement designs have been extended to cover up to 150msa and design CBR strengths up to 15%. In order to compute the damage ratio, the allowable repetitions are calculated in terms of the fatigue and rutting. The pavement design was done as per IRC-37-2012 and IIT Pave software. It accepts layer thickness, loading and material characteristics as inputs and has provisions for entering various indigenous data such as rutting and fatigue coefficients, wheel spacing, tyre pressure etc. The analysis is based on the linear elastic, multilayer theory and the stresses and strains developed in various layers of the pavement are obtained.

4.5.2 Design Life for Base and Sub-base Layers

The stage construction for first five years of pavement life is considered as an option. It would be appropriate to design the bottom non bituminous layers (base and sub-base) for axle loads expected in the 15 year design period the upper bituminous layers for axle loads expected at the end of 10 year design period. A 15-years design life has been considered for Base and Sub-base layers of flexible pavement.

4.5.3 Traffic Considerations

The base year traffic, traffic growth and the projected traffic for the design period for each category of vehicles have been arrived from the Traffic Studies. The commercial vehicle considered for the design are based on the vehicular projections considering the actual traffic, the traffic likely to be generated by future developments in the vicinity of the project road. Further, based on the traffic studies the number of commercial vehicles has been adopted.

4.5.4 Traffic Loading

In accordance with the requirement of IRC: 37-2012, the traffic loading for the design period and design lane are to be assessed. Vehicles constituting the commercial vehicles are LCV, 2 Axles, 3 Axles and Multi Axles and Multi Axle Semi Articulated vehicles.

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4.5.5 Design Approach and Criteria of Flexible pavement

Pavement distress resulting from repeated application of traffic;

- Horizontal tensile strain at the bottom of the bituminous layer
- Vertical compressive strain at the top of the Sub grade

4.5.6 Design Standards Related to Pavement Design

Design standards related to pavement design are essentially based on the guidelines given in IRC:37-2012 – "Tentative Guidelines for Design of Flexible Pavements".

Table 4. 1 Pavement Design Standards

	Design Parameters	Reference Code / Design Values
1.	Pavement Design	IRC: 37-2012- "Tentative Guidelines for Design of Flexible Pavements"
	Traffic Growth Rate	Adopted as per IRC: 37-2012
	Design Life	10 to 15 years
	Vehicle Damage Factor	Derived values based on Axle load survey. If these values are less than national average, then national average will be used.
	Lane Distribution Factor	As per IRC:37-2012
2.	Wearing Course Material	Bituminous Concrete

4.5.7 Information required for estimating design traffic

- Initial traffic in terms of number of Commercial Vehicles per day (CVPD).
- Traffic growth rate during the design life in percentage.
- Design life in number of years.
- Spectrum of axle loads.
- Vehicle Damage Factor (VDF).
- Distribution of commercial traffic over the carriageway.

4.5.8 Computation of Design Traffic

The design traffic in terms of the cumulative number of standard axles to be carried during the design life of the road should be computed using the following equation:

$$N = \frac{365 * \left[(1+r)^n - 1\right]}{r} * A * D * F$$

Where,

N = Cumulative number of repetitions in terms of million standard axles

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A = Initial traffic in the year of completion of construction in terms of the number of Commercial Vehicles per Day (CVPD).

D = Lane distribution factor (as explained in Para 4.5.1 (IRC: 37-2012)

F = Vehicle Damage Factor (VDF).

n = Design life in years.

r = Annual growth rate of commercial vehicles in decimal (e.g., for 5 per cent annual growth rate, r = 0.05).

Traffic Growth Rate

The present day traffic has to be projected for the end of design life at growth rates ('r') estimated by studying and analyzing the following data:

(i) The past trends of traffic growth; and

(ii) Demand elasticity of traffic with respect to macro-economic parameters (like GDP or SDP) and expected demand due to specific developments and land use changes likely to take place during design life.

If the data for the annual growth rate of commercial vehicles is not available or if it is less than 5 per cent, a growth rate of 5 per cent should be used.

The traffic in the year of completion is estimated using the following formula:

$$A=P(1+r)^n$$

Where,

P = Number of commercial vehicles as per last count.

n = Number of years between the last count and the year of completion of construction

4.5.9 Selection of Subgrade CBR for Pavement Design

The CBR values of the sub grade soil vary along a proposed alignment even on a homogeneous section. The pavement design is done based on Considering the CBR of Borrow area for Reconstruction and Widening Section and For Existing portion the CBR of Existing Sub grade / Sub base is considered.

4.5.10 Flexible Pavement Design – Re-construction

The CBR values of the subgrade soil vary along a proposed alignment even on a homogeneous section. The pavement design is done based on Considering the CBR of Borrow area for Reconstruction and Widening Section and For Existing portion the CBR of Existing Subgrade/Sub base is taken,

4.5.11 Widening Proposals & Typical Cross Sections

a) Widening options for the project road were arrived based on,

- Lane requirements based on traffic capacity analysis.

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- Requirement of service roads along built-up areas.
- Presence of religious structures.
- Availability of land

Formulation of carriageway widening schemes involves 1) estimation of extent of widening required in terms of additional lanes and 2) lateral arrangement of these additional lanes to the existing carriageway. Guidelines for the requirement of additional lanes is derived from, Traffic Study – Projected Traffic Volume vis-à-vis Capacity of each lane / road

Based on the TOR requirement of minimum Land Acquisition, i.e., within the existing ROW as far as possible, and retaining the existing pavement, cross drainage structures and bridges as far as possible, without compromising the recommendations of IRC / MORT&H.

Requirement of service roads along built-up areas. Additional lanes shall be added to the existing road either concentrically or eccentrically, depending on

1. The availability of right of way on either side of the existing centre line,
2. Topography and built-up areas
3. Due to specific field constraints (such as any sensitive features like water bodies, important structures etc.), localized shifting has been emerged at many places.

4.6 Proposed Improvements to Road Section

The proposals for the improvement of the geometric elements of the existing project road sections generally include:

a. Geometric Improvements

- Maintaining Uniform Carriageway.
- Improvements to cross sectional elements.

b. Strengthening of Existing Pavement

- Filling of potholes / damaged portion with WMM.
- Overlay for existing carriageway.
- Strengthening of Carriage way.

c. Road Drainage

- Desilting of Existing Side Drains.
- Rectification of damaged drains.
- Flagging Coarse for Existing Drain.
- Replacing damaged / Missing cover slabs.

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RIGID PAVEMENT DESIGN:

A) The rigid pavement consists of cast in-situ/ premix concrete.

The slab design method is based on assessments of the:

- Predicted traffic volume and composition over the design period
- Strength of the subgrade in terms of its California Bearing Ratio
- Strength of the base concrete

B) A bound of lean mix concrete sub-base is recommended under a concrete pavement for one or more of the following reasons:

- To resist erosion of the sub-base and limit 'pumping" at joints and slab edges.
- To provide uniform support under the pavement
- To reduce deflection at joints and enhance load transfer across joints (especially if no other load transfer devices are provided, such as dowels); and
- To assist in the control of shrinkage and swelling of high-volume-change subgrade soils

Table 3.1 Approximate k Value Corresponding to CBR Values

Soaked subgrade CBR	2	3	4	5	7	10	15	20	50
k Value (MPa/m)	21	28	35	42	48	50	62	69	140

Table 3.2 Effective k Values Over Granular and Cementitious Subbases

Soaked CBR	2	3	4	5	7	10	15	20	50
k Value over granular subbase (thickness 150 to 250 mm), MPa/m	25	34	42	50	58	60	74	83	170
k Value over 150 to 200 mm cementations sub base MPa/m	42	56	70	84	96	100	124	138	280

The composition of pavement layers from the above Detailed Design is shown in table below.

Pavement compositions

Recommended Layers		
PQC	**Base Course**	**Sub Base Course**
150	150	150

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Chapter - 5
PROJECT COST ESTIMATES

5.1 Detailed Cost Estimate

Detailed cost Estimate has been worked out based on detailed engineering design

5.2 General

Cost Estimate is an important part of the Report as it provides vital input to financial evaluation of the project. The cost estimates have been prepared for Strengthening of the existing road including strengthening of longitudinal drains, road furniture, site clearance and Dismantling.

5.3 Basic rates

As part of Report, Rate Analysis of each of the item has been prepared by adopting PW, P & IWTD SR 2021 - 22, Bangalore Circle. The rates as given in PW, P & IWTD SR are to be enhanced by 3% for additional weightages for the works to be executed under extra ordinary conditions for Bangalore Metropolitan Limits. Items not covered in NHSR / PW, P & IWTD SR have been based on market rates.

5.4 Project Management and Quality Control

Provision of around 2.0% of Construction Cost has been made towards Cost of DPR Preparation, Quality Control, PMC and Proof Checking.

5.5 Project Cost

The total project cost for the proposed work is 1600.00 Lakh.

Detailed Cost Estimate is enclosed in **Annexure A. 5.1**

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Chapter – 6
EXECUTIVE SUMMARY

The Project area is falls under Yelahanka Division, Yelahanka Assembly Constituency in Bangalore City. The Project area is located thickly populated Residential cum Commercial area. The Project Stretch includes connecting roads and cross roads. The spurt in the development of Bangalore City with creation of ITPL, Tech Parks, Layouts, and Education Institutions has resulted in change of the Land Use Pattern. Further, Bruhat Bangalore Mahanagara Palike has decided to take up the development of various Sub arterial, Collector and local streets where the intensity of traffic has increased significantly and there is a requirement for augmentation of capacity for safe and efficient movement of traffic. For the habitation resided in this area it was very difficult to commute on this stretch in the Rainy season due to non proper flow of water on the Roads and lack of proper drainage facility. By considering these reasons the roads are taken up for Development with Asphalting depending upon the site scenario. This being the Background, Bruhath Bangalore Mahanagara Palike has proposed for the following works in order to provide Seamless Traffic Flow and to Increase Level of Service along the Project Stretch.

For the proposed Improvement Scheme, total Cost of the Project has been worked out as Rs. 1600.00 Lakh.

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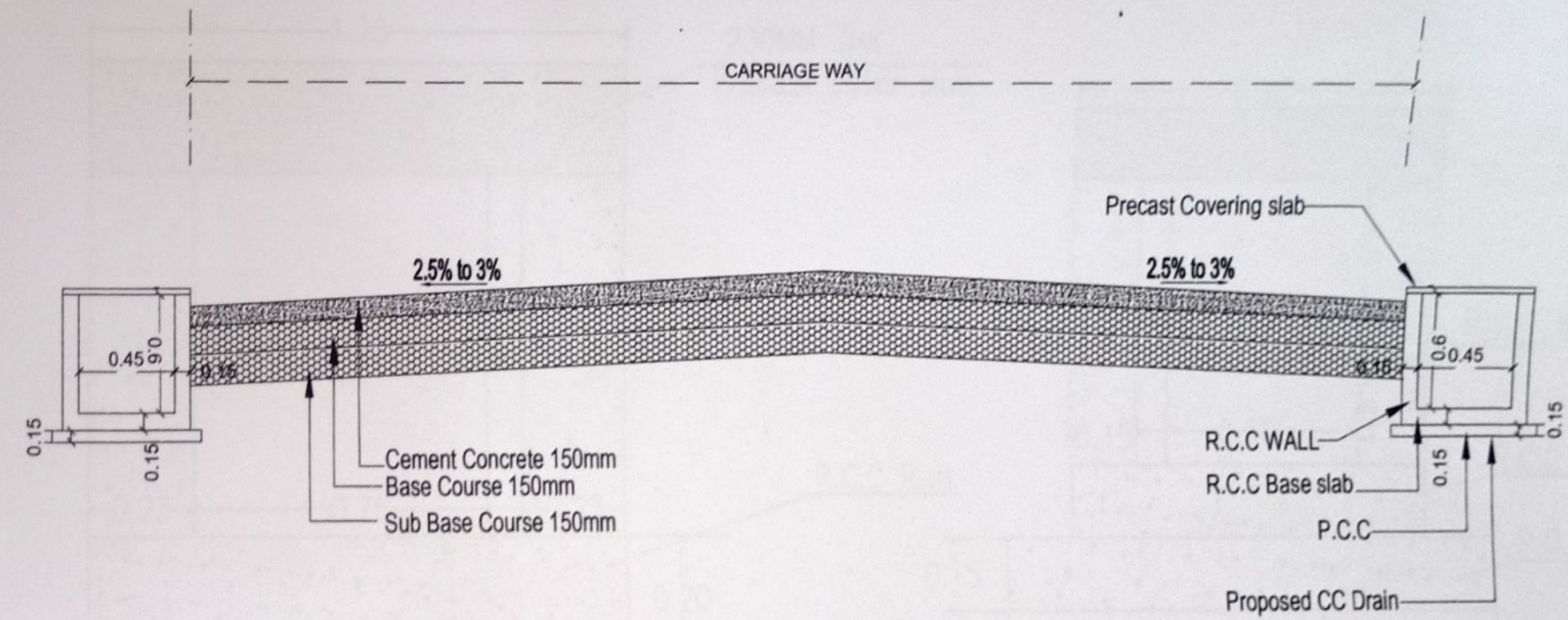

Proposed Typical Cross Section of Concrete Surface

CLIENT:	PROJECT	Dwg Title: SECTION OF ROAD	scale: N.T.S
BRUHAT BANGALORE MAHANAGARA PALIKE			Date
		Dwg no:	Rev. R0

eProcurement
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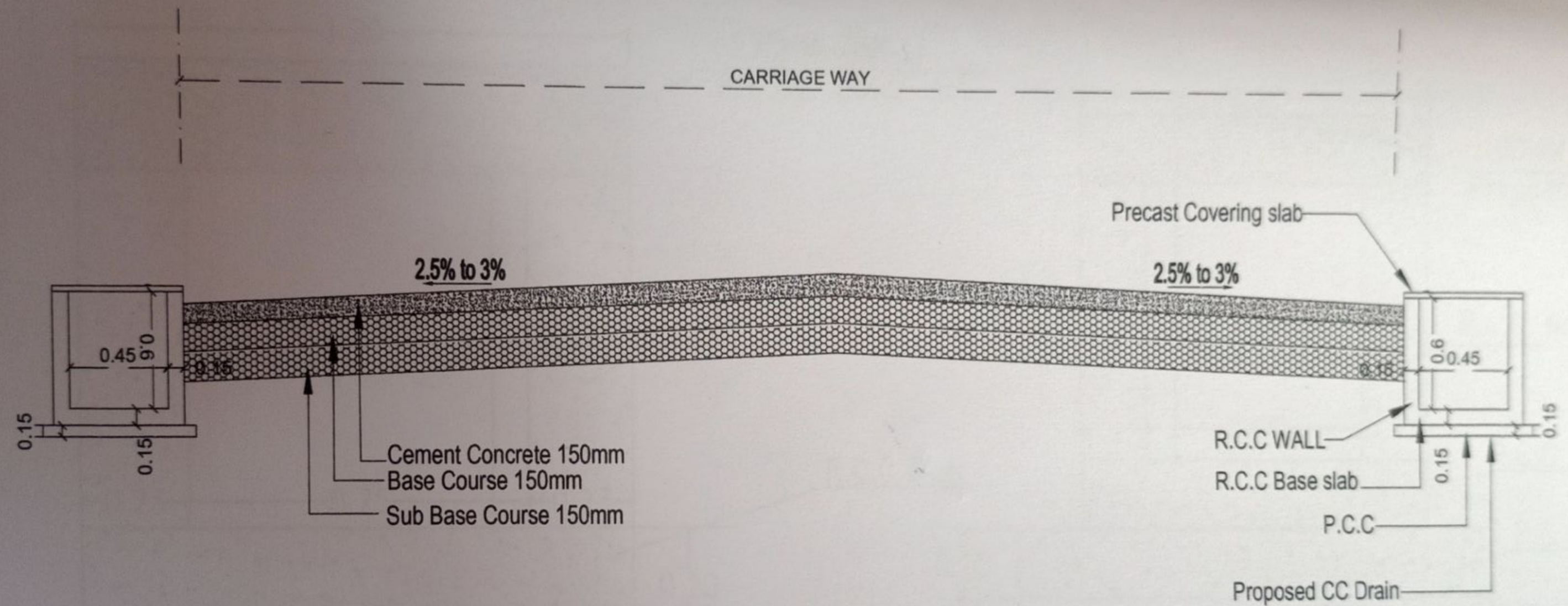

Proposed Typical Cross Section of Concrete Surface

CLIENT:	PROJECT	Dwg Title:	scale; N.T.S
		SECTION OF ROAD	Date
BRUHAT BANGALORE MAHANAGARA PALIKE		Dwg no:	Rev; R0

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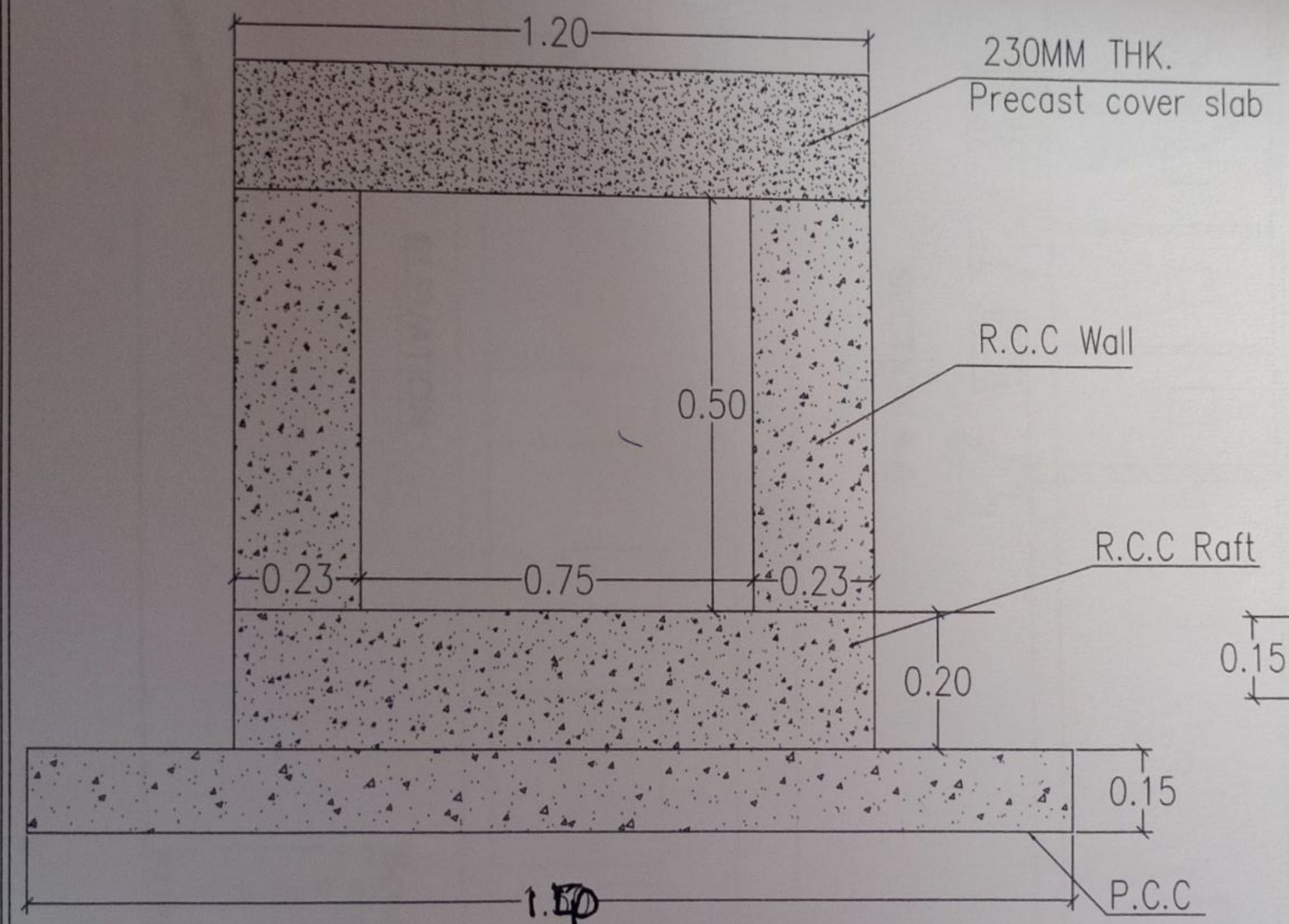
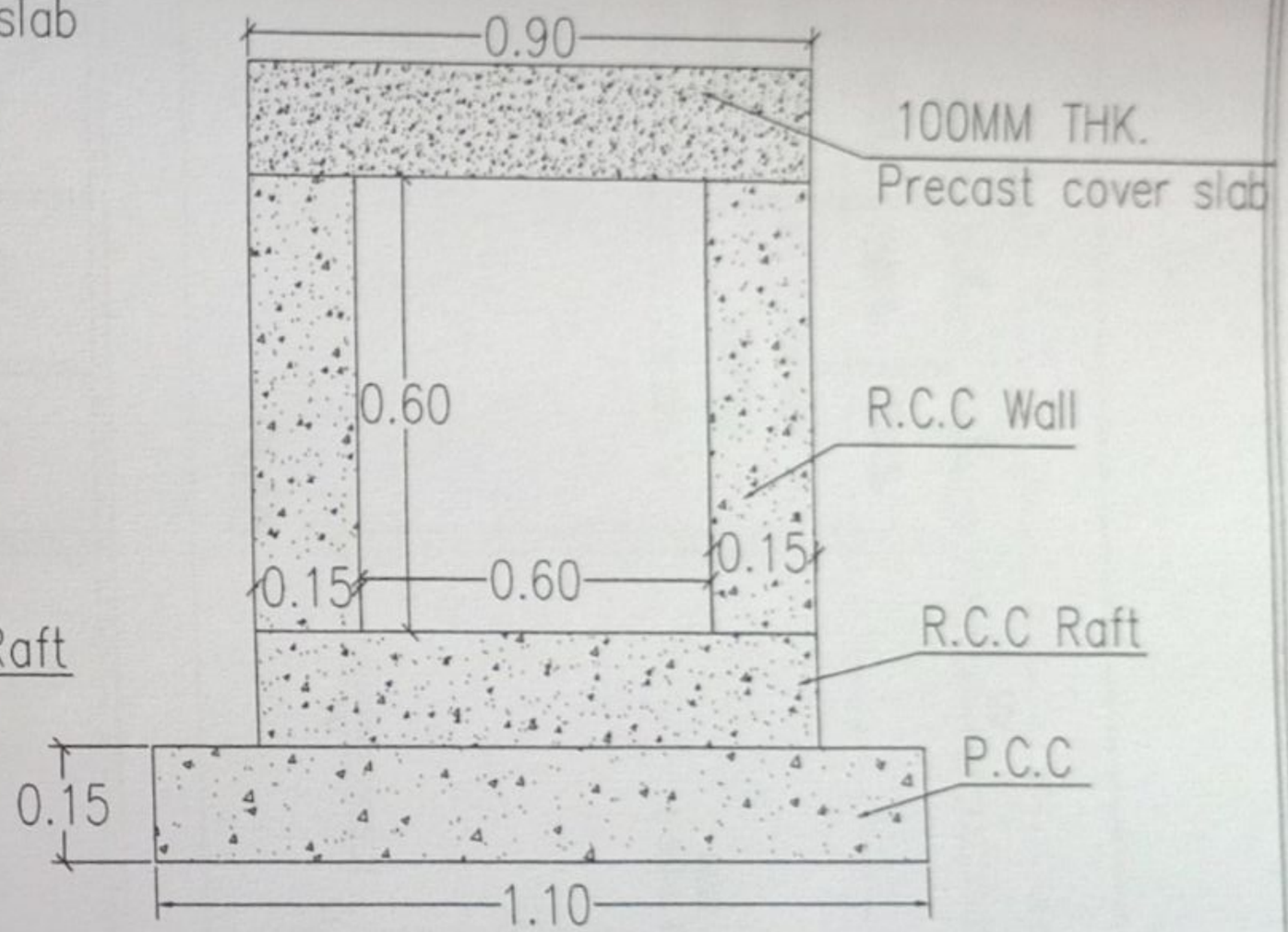


CROSS SECTION OF CULVERT



CROSS SECTION OF DRAIN

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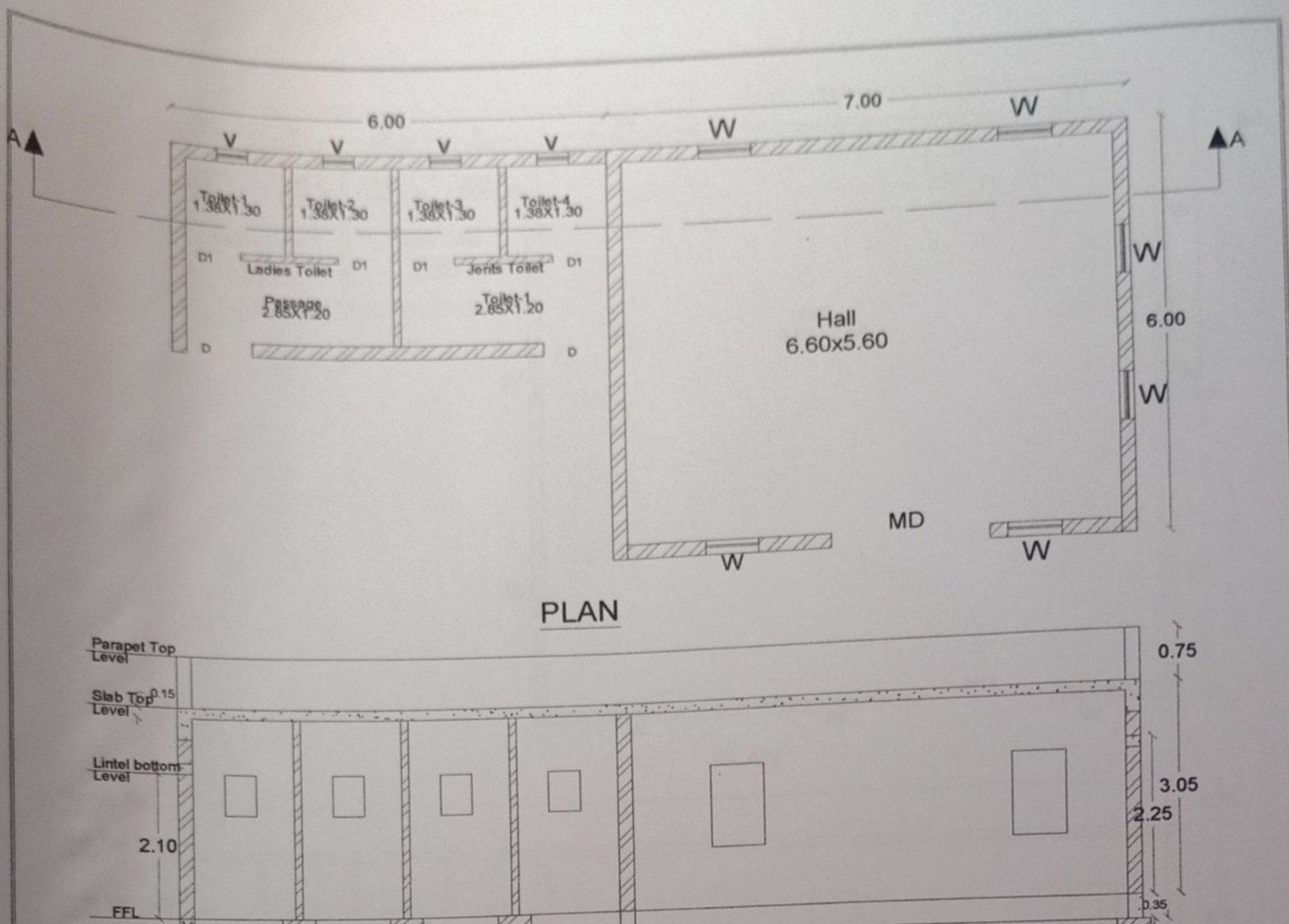

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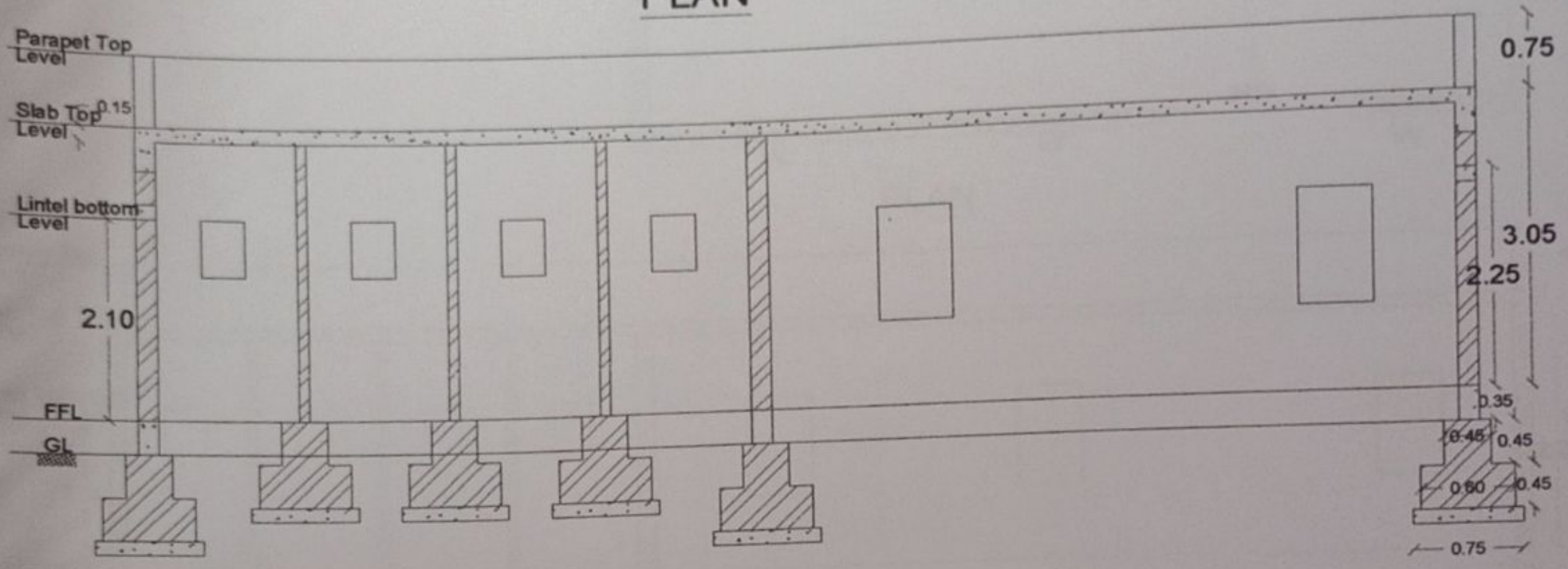
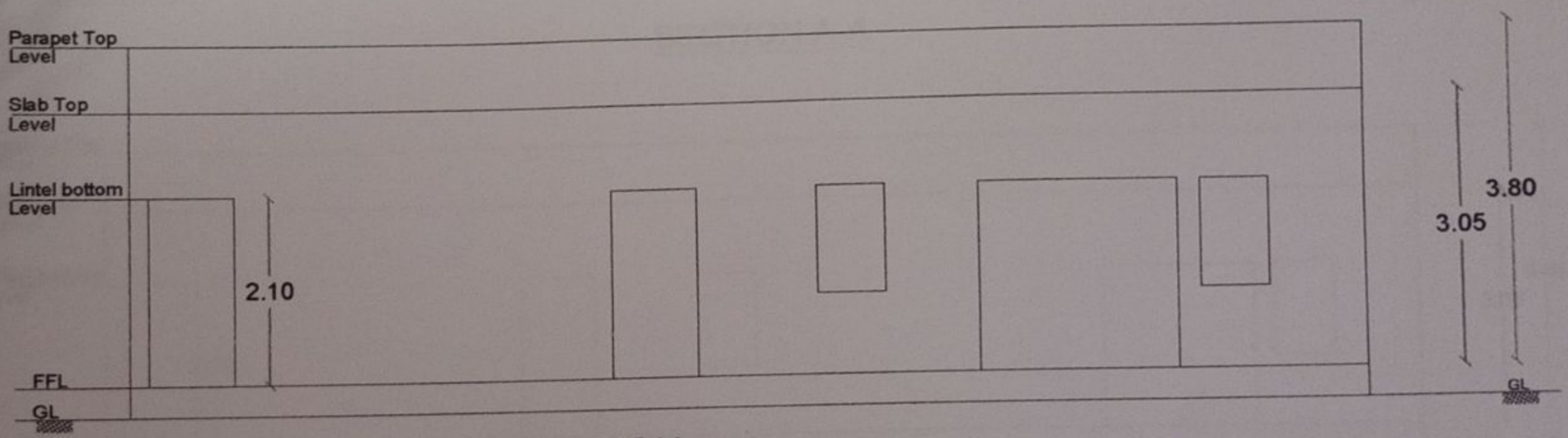


SECTION A-A



ELEVATION

Schedule of openings	
MD	1.80X2.10
D	0.90X2.10
D1	0.75X2.10
W	1.20X1.20
V	0.60X0.60
All Dimensions are in Meter	

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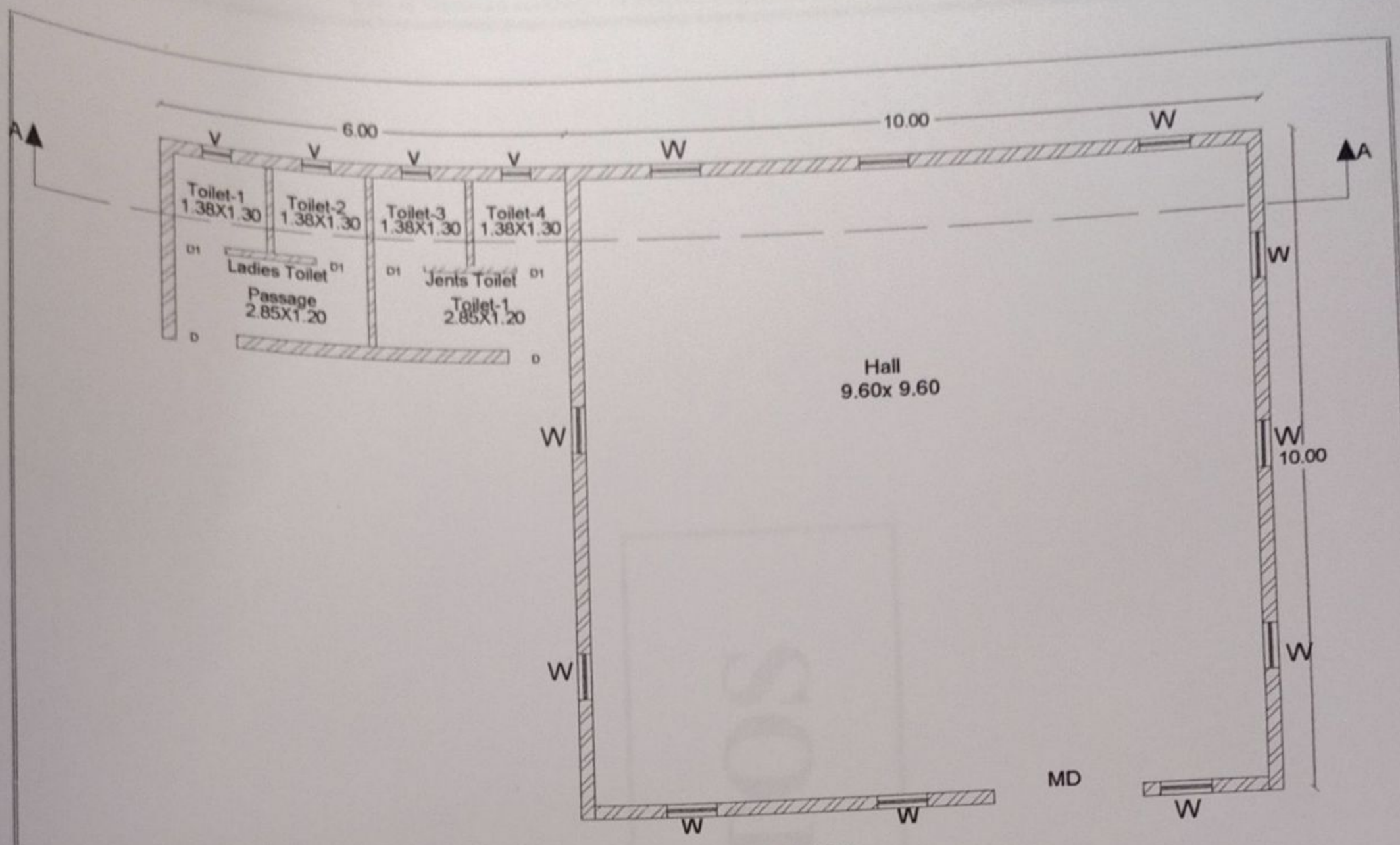
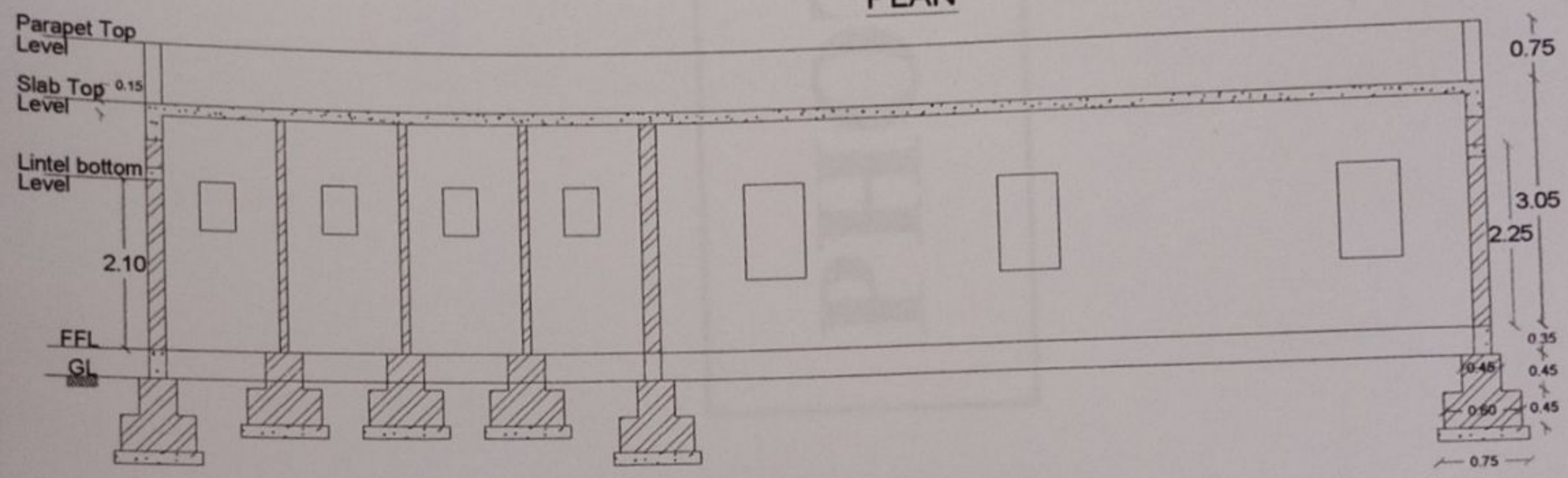
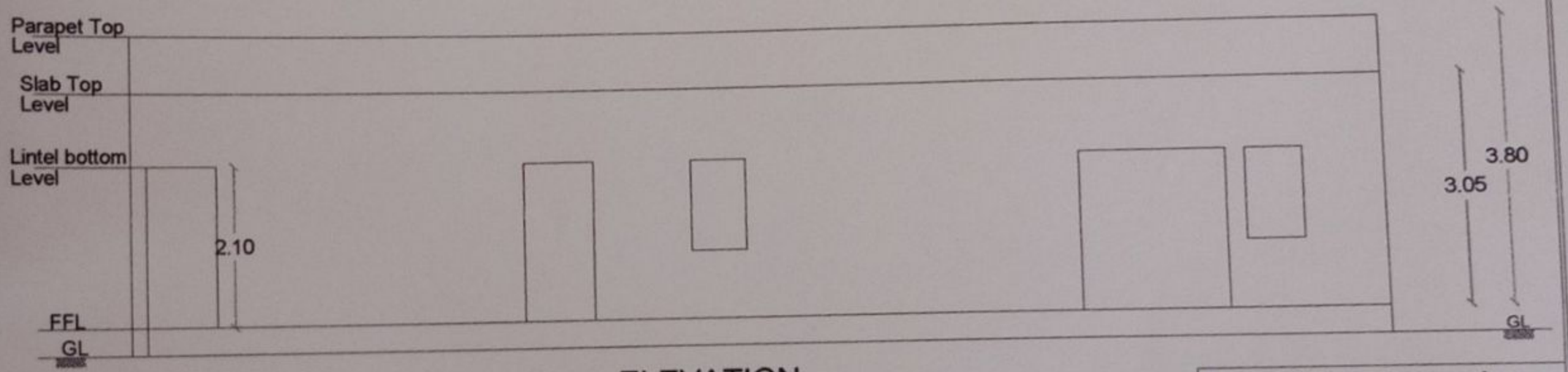


PLAN



SECTION A-A



ELEVATION

Schedule of openings	
MD	1.80X2.10
D	0.90X2.10
D1	0.75X2.10
W	1.20X1.20
V	0.60X0.60

All Dimensions are in Meter

Scanned by TapScanner